

**Exhibit A**  
**Cylindrical Coordinates Examples**

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## mathworld

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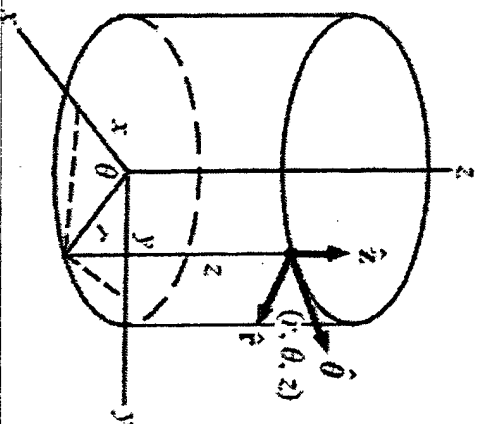
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## Cylindrical Coordinates

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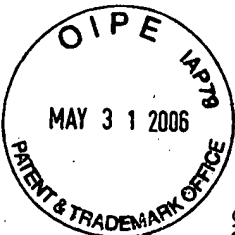
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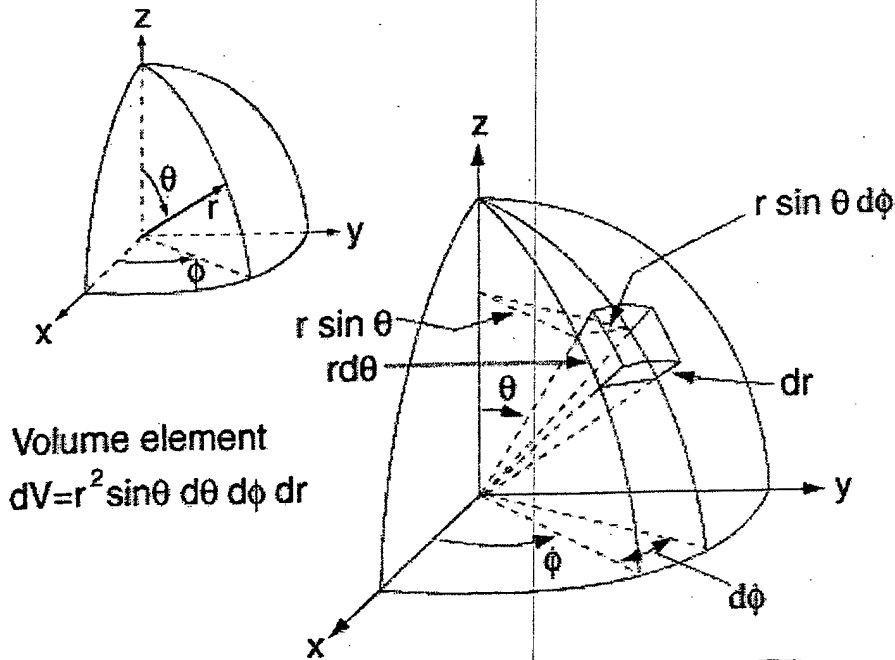
Cylindrical coordinates are a generalization of two-dimensional polar coordinates to three dimensions by superposing a height ( $z$ ) axis. Unfortunately, there are a number of different notations used for the other two coordinates. Either  $r$  or  $\rho$  is used to refer to the radial coordinate and either  $\phi$  or  $\theta$  to the azimuthal coordinates. Arfken (1985), for instance, uses  $\{\rho, \phi, z\}$ , while Beyer (1987) uses  $\{r, \theta, z\}$ . In this work, the notation  $\{r, \theta, z\}$  is used.

The following table summarizes notational conventions used by a number of authors.

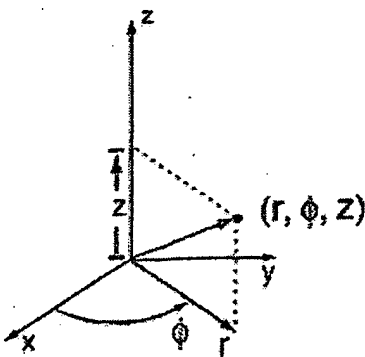
(radial, azimuthal, vertical)	reference
$\{r, \theta, z\}$	this work, Beyer (1987, p. 212)



# Spherical Polar Coordinates

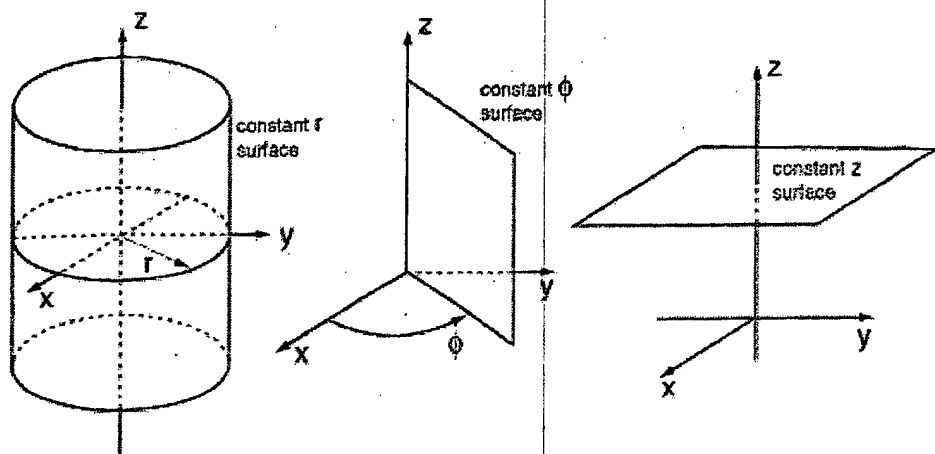

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# Cylindrical Polar Coordinates

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With the axis of the circular cylinder taken as the  $z$ -axis, the perpendicular distance from the cylinder axis is designated by  $r$  and the azimuthal angle taken to be  $\phi$ .

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## Applications of Spherical Polar Coordinates

Physical systems which have spherical symmetry are often most conveniently treated by using spherical polar coordinates.

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## Applications of Cylindrical Polar

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